

SEASONAL OCCURRENCE OF CHRYSOMELIDAE IN A
BLUESTEM PRAIRIE NEAR MANHATTAN, KANSAS

by

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INTRODUCTION

Many individual species of the Chrysomelidae, or leaf beetles, have been studied, but a study concerned with leaf beetle populations occurring in range lands here-to-fore has not been conducted. Many species have invaded the natural prairie along with new plant species which appeared because of range management or mismanagement. The main plants acting as chrysomelid hosts in the invaded prairies are goldenrod (Solidago), sage (Artemisia), ragweed (Ambrosia), and Aster. Other leaf beetles naturally occur in grasslands. These grass inhabiting species do most of their feeding during the larva stage, which is spent in the soil eating grass roots.

This study records the seasonal occurrence of the species collected over a two year period and provide a basis for future studies.

Collections for this study were taken weekly from three range sites in each of, nine treatments. Under a separate project the Department of Agronomy has made counts of the plant species present in each treatment and site.

REVIEW OF LITERATURE

The literature concerning chrysomelids is chiefly taxonomic, or concerned with the economic pests such as the corn rootworms. An attempt to cite all the literature is impractical. The majority of the literature reviewed concerns the occurrence of leaf beetles and records of host plant preference. References to life history are few; most chrysomelid species are considered to overwinter as adults.

Taxonomic works used to identify the species collected were Fall (1915), Wilcox (1949), and Wilcox (1954). Other taxonomic works were used to learn the range of each species. An outstanding reference for this information was Horn (1889). Blatchley (1910) and Wilcox (1954) listed the Chrysomelidae known to occur in Indiana and Ohio, respectively. The only extensive report on chrysomelids in Kansas is that of Douglas (1929), which also listed the known host plants and seasonal occurrence for a few species. Other references which gave host plant information were Woods (1924), Wickham (1897), and Beutenmuller (1890).

Reports of insects collected by others in grasslands gave comparative information for many of the species: Fautin (1946), Carpenter (1939), and Walkden and Wilbur (1944).

Hendrickson (1929) reported the insect fauna of Iowa prairies and noted the climax grass species where specimens were taken. Smith (1940a) investigated the effect of overgrazing and erosion on the biota of mixed prairies in Oklahoma. His study gave minor comparison of nine species found during this study. Smith (1940b) studied plant succession at different stages of development from abandoned eroded farmland to prairie climax stages, and reported the presence of chrysomelids in relation to the stage of succession of the plant fauna.

MATERIALS AND METHODS

Area of Study

The area of study was aptly discussed by Arnett (1960); and, because the material for this study came from samples collected during his study, that discussion will be used.

This study was made in the Donaldson Pastures located approximately 5 miles northwest of Manhattan, Kansas, which are representative of the Flint Hills area. The Flint Hills constitute a major segment of the remaining true prairie which once covered much of eastern Kansas. Its importance as a grazing region has been discussed by Anderson (1953). The vegetation is classified as true prairie and is dominated by mid-grasses such as little bluestem, sidecats grama, and such tall grasses as big bluestem, indiagrass, and switchgrass. Kentucky bluegrass had invaded the entire area. Short grasses are more abundant on the droughty, preclimax sites and on over-grazed areas.

There are nine pastures in this study which are under a series of utilization experiments by the Department of Agronomy under the direction of Dr. Kling Anderson. Each pasture has been mapped, and a series of range sites based on soil conditions, slope, and populations of major forage species has been delineated within each (Anderson and Fly, 1955).

Two sets of pasture experiments, one containing six pastures and the other three, are included in this study. Six are used in an intensity of grazing experiment and deferred grazing experiment, and three in a time-of-burning experiment. The range management practices being followed for each of the pastures are: (1) Intensity of grazing. In these experiments season-long stocking rates are 3.75, 5.00, and 7.50 acres per animal unit. This is considered to be heavy, moderate, and light grazing, and hence will be referred to as "heavily grazed," "moderately grazed," and "lightly grazed", respectively. (2) Deferred-rotation grazing. This series of pastures were in a deferred-rotation grazing experiment. Each pasture was stocked at a moderate rate. Two of these pastures carry all the cattle for the three pastures during May and June. On approximately July 1, all animals would be shifted to the deferred pasture. Toward fall, if the grass became short under this intensive use, the gates would be opened to allow free access to all three pastures. One pasture was deferred in 1951, 1954, and 1957, and will be referred to as "pasture deferred in 1957." A second pasture was deferred in 1949, 1952, 1955, and 1958, and will be referred to as "pasture deferred in 1958." The

third pasture of this series was deferred in 1950, 1953, 1956, and 1959, and will be referred to as "pasture deferred in 1959." (3) Time of burning. The second series of pastures was in a time-of-spring-burning experiment. (Although spring burning of pastures is usually burned in late March, one in mid-April, and one in late April, the exact time depending on weather conditions.)¹ These pastures will be referred to as "burned early spring," "burned mid spring," and "burned late spring", respectively. Each of these pastures was stocked season long at a rate of five acres per animal unit, which was considered a moderate rate of stocking.

Range sites within each of the nine pastures from which collections were obtained have been described by Anderson and Fly (1955) as follows: Ordinary upland-"having sufficient depth of soil with medium or loamy texture and hence with suitable soil-plant moisture relations to support the type of vegetation that is climax on the zonal soils of the regional climate." Limestone breaks-"similar to the above, but occurring on steeper slopes and, therefore, subject to somewhat greater loss of moisture by runoff and with less development (soil). The vegetation, however, is like that of the above site in its major features and may be considered climax in nature." Clay upland sites-"lands having sufficient depth of soil but with somewhat less infiltration, slower permeability, and a smaller percentage of water available to plants than ordinary uplands, hence supporting at best a somewhat preclimax vegetation." Claypan sites-"lands having sufficient depth of soil, but with even more restrictive water relations than the clay upland site, thus supporting a preclimax vegetation."

Herbel and Anderson (1959) described the changes that have taken place in the pastures in the intensity and deferred grazing experiments. Under heavy stocking, there was a reduction in some species of grasses (decreasers) and increase in other species (increasers), hence a shift in plant populations. The amount of mulch covering the ground was indicated to be less in the overstocked pastures than on the deferred and lightly stocked pastures. Less drastic differences in plant populations were noted in the moderately stocked pasture, and still less drastic population changes in the lightly stocked and deferred pastures.

Herbel (1954) noted some of the differences in the pastures under the time of burning experiment. A greater percentage of decreasers was found in the late burned pasture than in the early and midspring burned pastures. In burned pasture, the amount of mulch is less than in unburned pastures. Plant density was found to be less on the early and midspring burned pastures than on the late-spring burned pasture.

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Sweep Net Method of Collecting

The sweep method as a means of sampling population densities has been controversial for many years. Studies to determine validity of this method have been many. Grey and Treloar (1933) checked the accuracy of the sweep net for estimating the insect population in an alfalfa field and attempted to determine minimum numbers of sweeps required to obtain a valid sampling of the population. Beall (1935) compared the sweep method with the cylinder method. The big drawback of the cylinder method is time consumption reducing the area that can be covered. It also fails to accurately collect active insects such as chrysomelids.

DeLong (1932) fully discussed the weaknesses of the sweep method for insect survey. He concluded by saying, "the sweep method is undoubtedly of value in securing quantitative data and in determining the predominant and least prevalent species. . . ."

The sweep method of collections was very adaptable to pasture collections and the only economical feasible method for this study. Chrysomelids are predominantly leaf feeders as adults, and nocturnal. Therefore sweeping the plants with an insect net during the day provided a reasonable sampling technique for this study.

Collecting Procedure

The material for this study was collected with a specially constructed square rimmed net, with a one foot square opening.

Arnett (1960) discussed the time of collecting as follows:

Collecting in 1958 began April 18 and continued until

October 29; in 1959 it extended from May 8 until September 28. Collecting at regular, weekly intervals was intended, but because of wind or rain this was not always possible. Collections were made between 10 a.m. and 2 p.m. Collections from all treatments for a given week were made on the same day.

The collection for each range site consisted of 50 sweeps, divided equally between two collectors in different locations in each range site. Each sweep was taken at nine foot intervals with care to sweep in all types of vegetation and all areas of each range site.

Each net containing 25 sweeps was placed in a two-gallon cream can containing cyanide. After five minutes, the contents were removed from the nets and placed in quart plastic bags. Tags were attached to the bags giving date, range site and pasture number.

Collections were stored in a freezer in the laboratory until separation of the insects from debris could be made. Beetles of the 1958 collection were placed in paper envelopes to dry and were later stored. During 1959 beetles were dried in glass vials, then placed in one-half ounce, tin boxes for storage.

Early in 1960 the writer began his study of the preserved beetles. A series of specimens from the spring and summer of 1958 and specimens from the 1959 collections were sorted out, pinned, and labeled. These specimens were tentatively identified and were sent to Dr. D. M. Weisman at the U. S. National Museum to have the identifications checked.

The small, black species of the subfamily Alticinae or flea beetles were excluded from this study. They require genital dissection to be identified and would have been too time consuming. Even if there had been time for dissection of each specimen--over

1,000—the females could not have been identified.

RESULTS AND DISCUSSION

Tables 1, 2, 3, and 4 record occurrence in relation to pasture management and range sites. This will greatly expedite future studies on interrelationships. In addition, this information also facilitates discussion of certain species occurrence in relation to host plant counts.

Carpenter (1939) found the total insect population was higher on burned prairie and in seral stages than on undisturbed prairies. Smith (1940b) reported that overgrazing reduces the number of species and the number of specimens of Coleoptera. The Chrysomelidae in particular showed a marked drop in species and specimens in over grazed and eroded prairies in Oklahoma.

Considering all the specimens identified (table 2) there were no apparent differences between pastures with different types of pasture management. Samples from the three pasture sites show some variation. Thirty-four percent of the beetles came from limestone breaks, 40 percent from clay upland and 26 percent from ordinary upland (table 4).

Tables 5 to 21 present seasonal occurrence and actual numbers of specimens of each species taken on each collection date.

Tables One to Twenty-one

Table 1. Species and numbers of Chrysomelidae collected in 1958 from each of the nine pasture treatments. Manhattan, Kansas.

Species	Intensity of grazing			Deferred grazing			Spring burning			TOTAL
	:Light	Moderate	Heavy	1957	1958	1959	Early	Mid	Late	
<i>Diabrotica undecimpunctata</i> howardi Barber	108	123	104	93	112	83	115	145	105	988
<i>Parla thoracica</i> (Melsh.)	38	13	123	44	104	133	22	24	30	531
<i>Pachybrachis</i> spp.	62	50	67	17	35	50	57	29	37	404
<i>Pachybrachis othonus</i> (Say)	18	32	19	14	11	29	36	22	28	209
<i>Pachybrachis autolytus</i> Fall	13	19	9	6	13	6	13	48	27	154
<i>Aitica foliaceae</i> Lec.	27	36	31	6	6	5	26	4	9	150
<i>Notonota tristis</i> (Oliv.)	95	43	0	0	0	1	4	1	0	144
<i>Galerucella notulata</i> (Fab.)	18	50	11	5	8	10	9	7	0	118
<i>Chrysodina globosa</i> (Oliv.)	21	0	16	23	25	25	0	0	1	111
<i>Diabrotica atripennis</i> (Say)	3	3	8	12	21	12	4	4	19	86
<i>Saxinus omogera</i> Lec.	5	8	13	19	4	6	6	5	7	73
<i>Galerucella americana</i> (Fab.)	9	5	14	6	3	15	5	5	9	71
<i>Systena hudsonias</i> (Forst.)	0	5	32	1	11	0	12	3	1	65
<i>Luperodes</i> sp.	0	2	4	5	18	6	0	8	1	44
<i>Zygospila suturalis casta</i> (Rogers)	10	5	3	8	10	4	0	0	4	44
<i>Galerucella cribrata</i> (Lec.)	4	1	2	3	6	18	7	0	1	42
<i>Coscinoptera axillaris</i> Lec.	0	0	1	1	5	3	7	4	10	31
<i>Coscinoptera dominicana</i> (Fab.)	0	4	3	5	1	3	0	1	5	22
<i>Disomycha triangularis</i> (Say)	6	1	2	2	3	0	5	0	1	20
<i>Cryptoccephalus venustus</i> Fab.	7	0	2	3	1	3	0	0	2	18
<i>Basareus lituratus</i> var. <i>recurvus</i> (Say)	4	2	1	2	1	1	1	2	0	14
<i>Naecolaspis flavida</i> (Say)	1	0	2	1	2	2	0	4	0	12
<i>Pachybrachis hepaticus</i> (Melsh.)	3	0	0	1	2	3	0	0	0	9
<i>Disomycha admirabilis</i> Blatchley and D. <i>leptolineata</i> texana Schffr.	0	0	0	1	3	0	2	2	0	8
<i>Pachybrachis pubescens</i> (Oliv.)	0	0	2	0	1	0	3	1	0	7
<i>Phyllacthris parallelus</i> Horn.	1	0	0	0	0	0	5	1	0	7
<i>Oedonychis texanus</i> Crotch	0	4	0	0	2	0	0	0	0	6
<i>Naecolaspis favosa</i> (Say)	0	0	1	0	0	3	0	0	1	5
<i>Anisostena nigrita</i> (Oliv.)	0	0	1	2	0	1	0	0	0	4
<i>Graphops varians</i> Lec.	0	3	0	1	0	0	0	1	0	4
<i>Monoxia</i> sp.	0	2	0	1	1	0	0	0	0	4

Table 1. contd.

Species	Intensity of grazing			Deferred grazing		Spring burning			TOTAL
	Light	Moderate	Heavy	1957	1958	Early	Mid	Late	
<i>Oedionychis thymoides</i> Crotch	0	0	0	2	0	1	0	0	4
<i>Lema</i> sp. near <i>coloradensis</i> Linell	1	0	0	0	0	0	1	0	3
<i>Notonota puncticollis</i> (Say)	0	0	0	0	0	0	2	1	3
<i>Phyllobrotica decorata</i> (Say)	0	1	2	0	0	0	0	0	3
<i>Phyllecthris gentilis</i> var. <i>nigripennis</i> Lec.	1	0	0	0	0	0	2	0	3
<i>Trirhabda canadensis</i> (Kirby)	0	1	0	1	0	0	1	0	3
<i>Chrysollina auripennis</i> (Say)	0	1	0	0	0	1	0	0	2
<i>Graphops simplex</i> Lec.	0	0	0	1	0	0	1	0	2
<i>Lema trilineata</i> complex	0	0	0	0	0	0	1	1	2
<i>Acalymma vittate</i> (Fab)	0	0	0	0	0	0	0	1	1
<i>Macrolaspis</i> sp. prob. <i>lata</i> Schffr.	0	0	0	0	0	0	0	1	1
<i>Trirhabda borealis</i> var. <i>indigoptera</i> Blake	0	0	0	0	0	0	0	0	1
<i>Zygospila disrupta</i> (Rogers)	1	0	0	0	0	1	0	0	1
Total	456	414	473	285	409	424	343	302	3,434

Table 2. Species and numbers of Chrysomelidae collected in 1959 from each of the nine pasture treatments. Manhattan, Kansas

Species	Intensity of grazing			Deferred grazing			Spring burning			TOTAL
	Light	Moderate	Heavy	1957	1958	1959	Early	Mid	Late	
<i>Galerucella notulata</i> (Fab.)	72	231	36	28	62	83	159	130	38	839
<i>Paria thoracica</i> (Melsh.)	40	14	50	80	102	121	141	142	58	748
<i>Zygospila suturalis casta</i> (Rogers)	42	35	39	7	31	33	24	34	9	254
<i>Chrysodina globosa</i> (Oliv.)	8	11	6	35	16	43	1	00	0	120
<i>Pachybrachis</i> spp.	5	13	14	8	18	8	6	26	16	114
<i>Diabrotica undecimpunctata</i> howardi (Barber)	20	17	16	1	7	20	6	10	6	103
<i>Galerucella americana</i> (Fab.)	9	8	1	0	1	9	45	29	0	102
<i>Galerucella cribrata</i> (Lec.)	1	13	1	6	14	24	9	7	2	77
<i>Systena hudsonias</i> (Forst.)	9	2	10	6	12	4	3	17	5	68
<i>Luperodes</i> sp.	6	0	24	1	9	13	2	10	1	66
<i>Maecolaspis flavida</i> (Say)	4	1	10	4	25	1	2	4	6	57
<i>Modonota tristis</i> (Oliv.)	29	7	0	2	0	2	0	2	1	43
<i>Pachybrachis autolyceus</i> Fall	0	1	1	0	13	2	6	9	7	39
<i>Disonychia admirabilis</i> Blatch. and D. lepto-lineata texana Schffr.	1	0	0	3	3	5	9	10	3	34
<i>Saxinus omogera</i> Lec.	5	4	4	5	5	1	1	2	4	31
<i>Pachybrachis othonus</i> (Say)	0	0	0	1	7	6	5	66	4	29
<i>Coscinoptera axillaris</i> Lec.	0	3	2	1	7	2	0	9	2	26
<i>Pachybrachis pubescens</i> (Oliv.)	1	0	5	3	1	2	5	7	0	24
<i>Coscinoptera dominicana</i> (Fab.)	1	0	5	3	1	2	4	7	0	23
<i>Altica foliaceae</i> (Lec.)	3	1	1	1	0	1	11	3	1	22
<i>Diabrotica atripennis</i> (Say)	1	0	1	0	0	0	2	11	7	22
<i>Cryptoccephalus venustus</i> Fab.	2	2	1	1	3	1	3	4	3	20
<i>Graphops simplex</i> Lec.	4	0	0	0	0	1	10	3	0	18
<i>Bassarona lituratus</i> var. <i>recurvus</i> (Say)	2	1	1	4	1	1	4	1	1	16
<i>Naecolaspis favosa</i> (Say)	0	1	4	0	4	5	1	0	0	15
<i>Exema</i> sp.	11	0	0	0	1	1	0	1	0	14
<i>Oedionychis thymoides</i> Crotch	6	4	1	0	0	0	1	0	0	12
<i>Phyllecthris gentilis</i> var. <i>nigripennis</i> Lec.	0	0	4	0	2	1	1	3	1	12
<i>Oedionychis texanus</i> Crotch	2	2	1	0	0	1	1	1	3	11
<i>Phyllecthris parallelus</i> Horn	0	2	0	1	0	0	0	6	2	11

Table 2. concl.

Species	Intensity of grazing			Deferred grazing			Spring burning			TOTAL
	Light	Moderate	Heavy	1957	1958	1959	Early	Mid	Late	
<i>Pachybrachis hepaticus</i> (Melsh.)	0	2	0	0	0	0	2	1	1	6
<i>Cryptocephalus</i> sp. near <i>confluens</i> Say	1	0	1	0	0	0	1	1	1	5
<i>Lema</i> sp. near <i>coloradensis</i> Lindell	0	1	0	0	0	0	3	0	0	4
<i>Naecolaspis</i> sp. Prob. <i>lata</i> Schffr.	2	0	0	0	0	0	0	0	1	3
<i>Monoxia</i> sp.	0	0	0	0	3	0	0	0	0	3
<i>Myochrous equanotus</i> Lec.	0	1	0	0	0	0	1	1	0	3
<i>Zygospila disrupta</i> Rogers	1	0	2	0	0	0	0	0	0	3
<i>Anisostena nigrita</i> (Oliv.)	0	0	0	0	1	0	0	1	0	2
<i>Phyllobrotica decorata</i> (Say)	0	0	0	0	0	0	2	0	0	2
<i>Chlamys</i> sp.	0	0	0	0	1	0	0	0	0	1
<i>Chrysolina auripennis</i> (Say)	0	0	0	0	1	0	0	0	0	1
<i>Diabrotica longicornis</i> (Say)	0	0	0	0	1	0	0	0	0	1
<i>Graphops varians</i> Lec.	0	0	0	0	0	0	1	0	0	1
<i>Lema trilineata</i> complex	0	0	0	0	0	0	0	0	1	1
<i>Microrhopala cyanea</i> (Say)	0	0	0	0	0	0	0	1	0	1
<i>Nodonota puncticollis</i> (Say)	0	0	0	0	0	0	0	0	1	1
<i>Trirhabda borealis</i> var. <i>indigoptera</i> Blake	0	0	0	0	0	1	0	0	0	1
<i>Trirhabda canadensis</i> (Kirby)	0	0	0	0	0	1	0	0	0	1
Total 1959	288	377	241	201	352	395	472	499	185	3,010
Total 1958 and 1959	744	791	714	486	761	819	815	827	487	6,444
Percent of total	11.5	12.3	11.0	7.6	11.8	12.7	12.7	12.8	7.6	

Table 3. Species and numbers of Chrysomelidae found on three range sites; limestone breaks (LB), clay upland (CU), and ordinary upland (OU), in the nine pastures during 1958, Manhattan, Kansas.

Species	LB	CU	OU	TOTALS
<i>Diabrotica undecimpunctata howardi</i> Barber	340	288	360	988
<i>Parla thoracica</i> (Melsh.)	127	282	122	531
<i>Pachybrachis</i> spp.	209	75	120	404
<i>Pachybrachis othonus</i> (Say)	82	63	64	209
<i>Pachybrachis autolytus</i> Fall	115	24	15	154
<i>Altica foliaceae</i> Lec.	42	51	57	150
<i>Nodonota tristis</i> (Oliv.)	46	51	47	144
<i>Galerucella notulata</i> (Fab.)	41	49	28	118
<i>Chrysodina globosa</i> (Oliv.)	62	19	30	111
<i>Diabrotica atripennis</i> (Say)	39	20	27	86
<i>Saxinus omogera</i> Lec.	33	11	29	73
<i>Galerucella americana</i> (Fab.)	32	23	16	71
<i>Systema hudsonias</i> (Forst.)	40	4	21	65
<i>Luperodes</i> sp.	20	14	10	44
<i>Zygospila suturalis casta</i> (Rogers)	8	14	22	44
<i>Galerucella cribrata</i> (Lec.)	14	24	4	42
<i>Coscinoptera axillaris</i> Lec.	29	1	1	31
<i>Coscinoptera dominicana</i> (Fab.)	12	3	7	22
<i>Disonycha triangularis</i> (Say)	8	7	5	20
<i>Cryptocephalus venustus</i> Fab.	5	5	8	18
<i>Bassareus lituratus</i> var. <i>recurvus</i> (Say)	7	0	7	14
<i>Maecolaspis flavida</i> (Say)	4	1	7	12
<i>Pachybrachis hepaticus</i> (Melsh.)	0	8	1	9
<i>Disonycha admirabilis</i> Blatchley and <i>D. leptolineata</i> texana Schffr.	5	1	2	8
<i>Pachybrachis pubescens</i> (Oliv.)	7	0	0	7
<i>Phyllethris parallelus</i> Horn	0	7	0	7
<i>Oedionychis texanus</i> Crotch	4	2	0	6
<i>Maecolaspis favosa</i> (Say)	3	0	2	5
<i>Anisostena nigrita</i> (Oliv.)	2	0	2	4
<i>Graphops varians</i> Lec.	0	1	3	4
<i>Monoxia</i> sp.	2	2	0	4
<i>Oedionychis thymoides</i> Crotch	2	2	0	4
<i>Lema</i> sp. near <i>coloradensis</i> Linell	0	1	2	3
<i>Nodonota puncticollis</i> (Say)	1	0	2	3
<i>Phyllorhiza decorata</i> (Say)	3	0	0	3
<i>Phyllethris gentilis</i> var. <i>nigripennis</i> Lec.	3	0	0	3
<i>Trirhabda canadensis</i> (Kirby)	3	0	0	3
<i>Chrysolina auripennis</i> (Say)	1	1	0	2
<i>Graphops simplex</i> Lec.	1	1	0	2
<i>Lema trilineata</i> complex	2	0	0	2
<i>Acalymma vittata</i> (Fab.)	1	0	0	1
<i>Maecolaspis</i> sp. prob. <i>lata</i> Schffr.	0	0	1	1
<i>Trirhabda borealis</i> var. <i>indigoptera</i> Blake	1	0	0	1
<i>Zygospila disrupta</i> (Rogers)	1	0	0	1
	1,357	1,055	1,022	3,434

Table 4. Species and numbers of Chrysomelidae found on three range sites; limestone breaks (LB), clay upland (CU), and ordinary upland (OU), in the nine pastures during 1959, Manhattan, Kansas.

Species	LB	CU	OU	TOTALS
<i>Galerucella notulata</i> (Fab.)	204	493	142	839
<i>Parla thoracica</i> (Melsh.)	93	504	151	748
<i>Zygospila suturalis casta</i> (Rogers)	59	135	60	254
<i>Chrysodina globosa</i> (Oliv.)	47	41	32	120
<i>Pachybrachis</i> spp.	65	31	18	114
<i>Diabrotica undecimpunctata howardi</i> (Barber)	19	31	53	103
<i>Galerucella americana</i> (Fab.)	19	59	24	102
<i>Galerucella cribrata</i> (Lec.)	29	40	8	77
<i>Systema hudsonias</i> (Forst.)	42	13	13	68
<i>Luperodes</i> sp.	30	22	14	66
<i>Maecolaspis flavida</i> (Say)	17	20	20	57
<i>Nodonota tristis</i> (Oliv.)	29	8	6	43
<i>Pachybrachis autolytus</i> Fall	25	7	7	39
<i>Disonycha admirabilis</i> Blatch. and <i>D. leptolineata</i> texana Schffr.	23	9	2	34
<i>Saxinus omogera</i> Lac.	10	12	9	31
<i>Pachybrachis othonus</i> (Say)	10	9	10	29
<i>Coscinoptera axillaris</i> Lec.	16	5	5	26
<i>Pachybrachis pubescens</i> (Oliv.)	16	6	2	24
<i>Coscinoptera dominicana</i> (Fab.)	15	6	2	23
<i>Altica foliaceae</i> (Lec.)	16	3	3	22
<i>Diabrotica atripennis</i> (Say)	9	6	7	22
<i>Cryptocephalus venustus</i> Fab.	2	12	6	20
<i>Graphops simplex</i> Lec.	5	3	10	18
<i>Bassareus lituratus</i> var. <i>recurvus</i> (Say)	4	9	3	16
<i>Maecolaspis favosa</i> (Say)	3	4	8	15
<i>Exema</i> sp.	3	0	11	14
<i>Oedionychis thymoides</i> Crotch	4	0	8	12
<i>Phyllethriss gentilis</i> var. <i>nigripennis</i> Lec.	3	5	4	12
<i>Oedionychis texanus</i> Crotch	7	2	2	11
<i>Phyllethriss parallelus</i> Horn	2	9	0	11
<i>Pachybrachis hepaticus</i> (Melsh.)	0	5	1	6
<i>Cryptocephalus</i> sp. near <i>confluens</i> Say	1	3	1	5
<i>Lema</i> sp. near <i>coloradensis</i> Lindell	2	0	2	4
<i>Maecolaspis</i> sp. prob. <i>lata</i> Schffr.	1	0	2	3
<i>Monoxia</i> sp.	0	0	3	3
<i>Myochrous squamosus</i> Lec.	0	1	2	3
<i>Zygospila disrupta</i> Rogers	1	2	0	3
<i>Anisostena nigrita</i> (Oliv.)	1	0	1	2
<i>Phyllobrotica decorata</i> (Say)	1	1	0	2
<i>Chlamisus</i> sp.	1	0	0	1
<i>Chrysolina auripennis</i> (Say)	1	0	0	1
<i>Diabrotica longicornis</i> (Say)	0	1	0	1
<i>Graphops varians</i> Lec.	1	0	0	1
<i>Lema trilineata</i> complex	1	0	0	1

Table 4. concl.

Species	LB	CU	OU	TOTALS
<i>Microthopala cyanea</i> (Say)	1	0	0	1
<i>Nodonota puncticollis</i> (Say)	0	0	1	1
<i>Trirhabda borealis</i> var. <i>indigoptera</i> Blake	0	1	0	1
<i>Trirhabda canadensis</i> (Kirby)	0	1	0	1
Total 1959	838	1,519	653	3,010
Total 1958 and 1959	2,195	2,574	1,675	6,444
Percent for each site	34	40	26	

Table 5. Number of adult *Shrynosallidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Paria thersania</i> (Walsh.)</u>						
1958						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	50	22 124 79 71 25	49 35 19 22 13 13		1	
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	43	255 113 206 41	25 17 6 25 12	4 1		
<u><i>Diabrotica undecimnotata</i> Howard Barber</u>						
1958						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	2 1 1		1 1 1 1 1 3	63 55	25 418 252 78	64 10 1 3
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1 1	1 1	2 4 3 10 2 1 9	7 14 47		
<u><i>Galerucella notulata</i> (Fab.)</u>						
1958						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1 1	1 2 1	7 3 5	12 8 10 8	5 16 15 16 7
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	3 46	184 50 79 54	49 29 36 44 29	30 38 36 46 29	18 22 17	

Table 6. Number of adult *Chrysomelidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<i>Pschyrachia</i> spp.						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 7 47 66	86 65 44 55	50 16 6	1 1	1	
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1 10 16 37 23	8 6 3 3 5 1			1	
<i>Zucconella auturalia</i> sata (negers)						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 1 1	1 1	2 1 1 2 5 3 4	1 3 4 5 3 4		
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	3 4 2 20 12	3 10 6 18 22	45 34 11 27 4	3 28 2		
<i>Pschyrachia ethensis</i> (Gay)						
1958						
Day of month:	5 9 16 25	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 45 52 44 23 18	8 9 5 1 2	1			
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	4 2 12 6 2	1 1				

Table 7. Number of adult Chrysomelidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u>Chrysomelinae</u>						
<u><i>Chrysomelinae</i> (Oliv.)</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	12 16 58 19	1 2 1		1 1		1 1
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	4 34 51	20 10 1				
<u><i>Pachybrachis autolytus</i> Fall</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 18	21 21 20 28 11	21 8 3 2			
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		4 18 4 1	5 2 1 1 3			
<u><i>Medania tristis</i> (Oliv.)</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1 46 46 37 7	6 1			
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		8 15 4 11	4 1			

Table 8 . Number of adult Chrysomelidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Galerucella americana</i> (Fab.)</u>						
1958						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 2	2 6 1 9 1 18 5 1 6	3 2 3	2 2 1 4	1 1 1 1	
1959						
Day of month:	8 15 25	2 9 17 29	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1	24 4 5 4 2 1	2	29 18 4 6 2	1 2	
<u><i>Altica follicularis</i> Lec.</u>						
1958						
Day of month:	5 9 16 23	9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		2 5 3	22 39 12 23 8	7 14 1 2	2 2 2 1	1 4
1959						
Day of month:	8 15 25	2 9 17 29	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1	1 4 1 2	5	3 4	1	
<u><i>Systena hudsoniae</i> (Forst.)</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		7 32 10 9 3 2	1	1		
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	6 4	16 23 8 3	6	1 1		

Table 9. Number of adult *Chrysomelidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<i>Galerucella sibirica</i> (Lec.)						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1	11 1 5 4 4 1	1 1 1	3 1 5 5	2	
1959						
Day of month:	8 15 25	2 9 17 29	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1 5	2 7 20 1	3 1 2 4 2	9 2 5 5	3 7	
<i>Leucosticte sp.</i>						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:				1 8 11 13	3 6 2	
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:			1 18	7 36 4		
<i>Diabrotica sibirica</i> (Say)						
1958						
Day of month:	5 9 16 25	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		9 3 17 27	13 15 1 1			
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		5 5 2 3	3 1 3			

Table 10. Number of adult Rhysomalidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Saxilus omocera</i> Lec.</u>						
1958						
Day of month	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections	1 16	10 21 10 10 4	1			
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections	3	9 13 1 5				
<u><i>Macolaspis flavida</i> (Say)</u>						
1958						
Day of month	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections		2 5	2 2 1			
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections	1	3	1 1 26 6	18 1		
<u><i>Geocochorus willacis</i> Lec.</u>						
1958						
Day of month	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections		2 9 8 1 1 6	2 2			
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections	1	8 5 9 1				

Table 11. Number of adult *Thryonomidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Oecomys dominicensis</i> (Fab.)</u>						
Day of month:	5 9 16 29	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 5	6 8 1 1				
<u>1959</u>						
Day of month:	8 15 25	2 9 17 29	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	2 1 8 8 2	1 1				
<u><i>Oecomys admirabilis</i> Stach. and <i>O. lentiginos</i> Texan Bohfr.</u>						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1		2 1	1 1 1	1
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1 2 4	1 2 3 2 5 1	7 3 2	1		
<u><i>Erythroninus venustus</i> Fab.</u>						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1 5 2 3 2 2 1	2			
<u>1959</u>						
Day of month:	8 15 25	2 9 17 29	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		8 3 4 1 1	1	1		

Table 12. Number of adult Chrysomelidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Pachyrhynchus subescens</i> (Oliv.)</u>						
1958						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 16 24	1 8 15 22 29
Collections:	2 2 3					
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	2 1 8	8 2 1 2				
<u><i>Basanus lituratus</i> var. <i>rescurus</i> (Say)</u>						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	4 3	1 1 2 2 1				
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	2 5	2 2 2 3				
<u><i>Graphops alpinus</i> Lec.</u>						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1		1			
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	3 7	2 1 1	2	1		2

Table 13. Number of adult Chrysomelidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Macroleptus fovea</i> (Say)</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1 1 1 2				
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		1 5 7 2				
<u><i>Glaucantha triangularis</i> (Say)</u>						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		8 4 2 3 -1 1			1	
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:						
<u><i>Chylactis parvulus</i> Horn.</u>						
1958						
Day of month:	5 9 16 25	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		2 2 1 2				
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		1	1 1 3	1 1 3		

Table 14. Number of adult *Chrysomelidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Oedonochila texana</i> Grotch</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		2	1	1	1 1	
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1	1 1 1	3	1 1	1 1	
<u><i>Oedonochila thymusoides</i> Grotch</u>						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	2 1		1			
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	2	1 1	1 1 1 2 1		2	
<u><i>Pachybrachis benaticus</i> (Walsh.)</u>						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		7	1		1	
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		1 3	1	1		

Table 15. Number of adult *Chrysomelidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<i>Chylactris gentilis</i> var. <i>nicaragensis</i> Lee. 1958						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1	1				
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1	5 4 2				
<i>Erebia</i> sp. 1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:						
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1			2 3 4	4	
<i>Lema</i> sp. near <i>goleioides</i> Linell 1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:	1 1	1				
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1	1		2		

Table 16. Number of adult *Thryonomidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Monoxia</i> sp.</u>						
1958						
Day of month	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections	1		1	2		
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections		3				
<u><i>Anisostana alarika</i> (Oliv.)</u>						
1958						
Day of month	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections	1	1	2			
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections	1			1		
<u><i>Gerrhonotus</i> sp. near <i>confusus</i> Say</u>						
1958						
Day of month	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections						
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections		2	2	1		

Table 17. Number of adult Chrysomelidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Graphena varians</i> Lec.</u>						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		2			1	1
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	5 11 17 24 31	9 15 28	
Collections:				1		
<u><i>Phyllotreta decorata</i> (Say)</u>						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		3				
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:	1	1				
<u><i>Macroleptis</i> sp. prob. <i>lata</i> Schiff.</u>						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:					1	
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:						3

Table 16. Number of adult *Shryomelidae* per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u><i>Indarbacia canadensis</i> (Kirby)</u>						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		2		1		
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	5 9 15 28	
Collections:		1				
<u><i>Neodonta puncticollis</i> (Say)</u>						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1 1		1		
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	5 9 15 28	
Collections:		1				
<u><i>Zynacalla disrupta</i> (Rogers)</u>						
Day of month:	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1				
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	5 9 15 28	
Collections:		1		1		

Table 9. Number of adult Chrysomellidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u>Chrysomella auricollis (Say)</u>						
1958						
Day of month	5 9 16 23	5 9 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections	2					
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections					1	
<u>Lea trilobata complex</u>						
1958						
Day of month	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections		1			1	
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections		1				
<u>Brachyura saucicauda Lec.</u>						
1958						
Day of month	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections						
1959						
Day of month	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections		1 1				

Table 20. Number of adult Chrysomellidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<u>Trichabna borealis</u> var. <u>indissecta</u> Stål						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:		1				
<u>1958</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:		1				
<u>1959</u>						
<u>Asalyema vittata</u> (Fab.)						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:			1			
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:						
<u>Chlamys</u> sp.						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:						
<u>1959</u>						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	
Collections:					1	

Table 21. Number of adult Chrysomelidae per collection date, 1958 and 1959. Manhattan, Kansas

	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
<i>Diabrotica longicornis</i> (Say)						
1958						
Day of month:	5 9 16 23	5 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:						
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	1
Collections:						
<i>Hierosella swana</i> (Say)						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:						
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	1
Collections:						
<i>Hierosella swana</i> (Say)						
1958						
Day of month:	5 9 16 23	3 11 20 26 30	7 14 22 28	4 11 18 27	1 11 18 24	1 8 15 22 29
Collections:						
1959						
Day of month:	8 15 25	2 9 17 23	1 7 13 20 29	3 11 17 24 31	9 15 28	1
Collections:						

Discussion of Individual Species

Seasonal occurrences are given in tables 5-21 along with the date of each collection. Species are arranged in tables 5-21, and in the following discussion in descending order of abundance.

Paria thoracica (Welsh.). This black chrysomelid was reported by Wilcox (1957) as common throughout the eastern United States and Canada with Arizona, Kansas, and Oklahoma represented as the western limits by the specimens before him.

Wilcox (1954) listed goldenrod (Solidago spp.) as the common host. To this host he added (1957) Aster spp., Amaranthus retroflexus, Fragaria virginiana, and Vitis. He suggested that the last three were incidental hosts which were attacked after the destruction of goldenrod or aster by the population which built up on these two primary hosts.

The first specimens were collected May 23, and the last September 11. The population increased during the last week in May, reached its peak in mid-June, and rapidly fell off early in July, and then faded out by mid-August (table 5). The seasonal distribution suggests a one year life cycle. Eggs are probably laid on the host plants in June; thus the larvae reach maturity before the leaves of the plants begin to dry.

Goldenrod appears in the spring and provides food for the adults, while its roots supply food for the larvae. The adults emerge in the fall in time to find a place to overwinter. At this time of year the goldenrod is dry so the adults probably do not feed before hibernating.

Of the 1,279 adults, 62 per cent came from the clay upland sites, 21 per cent from ordinary upland sites, and 17 per cent from limestone breaks. The 62 per cent from the clay upland coincides with the 60 per cent of the Solidago counts in 1958 and 1959 from the clay upland areas (tables 3 and 4).

Diabrotica undecimpunctata howardi Barber. The spotted cucumber beetle, according to Arant (1929) is found in practically all parts of the United States east of the Rocky Mountains, in southern Canada, and in Mexico. In Kansas it is an important agricultural pest as well as in southern United States.

Arant (1929) states that adults may be found upon most species of field and garden plants. This black spotted beetle feeds primarily upon the pollen, petals, and essential flower organs of many flowering plants. Also, they have been observed feeding upon leaves or tender stems of many plants of which the list runs into the hundreds. Carpenter (1940) and Smith (1940b) list D. undecimpunctata howardi as wide spread in prairies. Smith found the adults more numerous as the prairie approached the climax stage. The white larvae which live on the roots of grasses are also a very important corn insect in the United States.

Sweetman (1926) reports one generation per year in Iowa, and Arant (1929) three generations per year in Alabama. The data in table 5 suggest one generation per year in Kansas. The adults overwinter and have been observed moving about in January. Eggs are laid early in the spring and apparently the larvae do not mature until August, with the peak occurring during September (table 5).

Galerucella notulata (Fab.). Horn (1893) listed the entire region east of the Rocky Mountains from Canada south into Mexico as the area inhabited by this dull, brown species. Wickham (1897 and 1902) reported specimens from Canada and Colorado, and Douglas (1929) reported several specimens from Kansas.

Woods (1924) listed Ambrosia artemesiaefolia L. as the host; Wilcox (1954) and Smith (1940b) mentioned ragweed without mentioning the species. Smith (1940b) found the occurrence of G. notulata in eroded farmland sub-climax stages, to correlate with the distribution of ragweeds. Smith (1940a) did not find this species in climax prairies, which probably correlates with the absence of ragweed. Ambrosia psilostachya counts were made in the area studied and will be referred to as the host in the following discussion.

This species responded to the build up of Ambrosia in 1958 and became abundant the following year. For the two years 1958-1959, Ambrosia constituted 61.5 per cent in 1958; and 38.5 per cent in 1959. The same trend was found when the 1957-1958 counts were compared. In 1957, 37.5 per cent of the two year total of Ambrosia occurred compared to 62.5 per cent during 1958. The large per cent of G. notulata collected in 1959 were no doubt a result of the abundance of host plants available to the larvae in 1958 (tables 3 and 4).

The clay upland sites supplied 59 per cent of the collections in 1959. The same sites in 1958 contained 45 per cent of the Ambrosia counts (tables 3 and 4).

Blatchley (1910) gave May 25 to July 25 as the time of occurrence in Indiana. The material collected for this study appeared May 15 to October 29 with one peak, June 1, and an even distribution

for the rest of the summer (table 5).

Mutchler and Weiss (1926) reports G. notulata had two generations per year in New Jersey, and they found adults hibernating beneath logs and mullein leaves in sandy locations. The number of generations per year in Kansas is apparently two or more.

Pachybrachis spp. More than five species are included in this group. This group of small, robust, cylindrical beetles contains three distinct groups of color patterns, plus many more indistinctly colored individuals. No attempt to determine the species of this group was made for it requires removal of the aedageus of each male. This procedure was beyond the scope of this study, and even if time had been available, females could not have been identified.

Smith (1940b) referred to the larvae of this group as root feeders. He found Pachybrachis common in near climax prairie in his study of succession of abandoned farmland in Oklahoma. Schwitzgebel and Wilbur (1942) observed fifteen specimens of Pachybrachis spp. on Vernonia interior near Manhattan, Kansas from May to August. Fall (1915) referred to the western species of Pachybrachis as not feeding on any definite food plant. The larvae being sac-beares, plus feeding on plant parts other than the foliage, makes them difficult to find.

Distribution of this group was quite stricking. Limestone breaks supplied 66 per cent of the 1959 collection and 52 per cent in 1958. The lightly grazed pasture produced 66 per cent of the total collections and the moderately grazed pasture 27 per cent leaving only 7 per cent for the other seven pastures. An interesting interrelationship with plants present is indicated, (tables 1, 2, 3, and 4).

Zygospila suturalis casta (Rogers). This brown and yellow striped beetle is common throughout Illinois and occurs in the western and wouthern states (Blatchley, 1910). Hendrickson (1929) took this species at Stanhope, Iowa, Douglas (1929) reported it in Kansas, and Posell (1932) reported it throughout Nebraska with a peak during June and July.

The following discussion will be taken from references to Z. suturalis without specifying the variety casta. Blatchley reported Z. suturalis in Indiana from April to December on ragweed. Edwards (1949) reported finding specimens on ragweed in the spring and on goldenrod flowers in the fall. Schwitzgebel and Wilbur (1942) observed or collected six specimens of Z. suturalis on iron weed, (Vernonia interior) near Manhattan, Kansas during July.

Z. suturalis var. casta was collected May 15 to October 15. A number of specimens were collected in mid-June which were probably the adults that lived through the previous winter. The peak number of adults occurring in the last week of July through August, were probably the representatives of the generation for that year. If so this variety has one generation per year in this area (table 8).

The predominance of this variety in the clay upland sites in 1959 is parallel with the predominance of Ambrosia and Solidago in the same area (table 4).

Pachybrachis othonus (Say). Fall (1915) reported this species as common in Kansas, and occurs throughout Canada and the entire United States.

This small, yellow and black species is a general feeder as indicated by reports in the literature. Wilcox (1954) reported ash

and elm, Fall (1915) Fraxinus americanus and Carix sp., and Hendrickson (1928) reported its presence in most grass communities in Iowa.

Blatchley (1910) and Fall noted June to July for the occurrence of adults of P. othonus from Indiana to New York. The Kansas State University specimens of P. othonus are dated May 25 through July. During 1958, specimens of this study were collected from May 16 to August 11 (table 8).

This beetle apparently spends a long time as larvae or in hibernation as the adults disappear in mid-summer and do not reappear in abundance until late May or early June. The population peak occurred in early June and decreased in late July. The three soil types were equally productive in 1959 for this species but clay upland produced 53 per cent of the individuals in 1958 (tables 3 and 4). This may have been due to the larger per cent of herbage plants in the clay upland sites compared to the other range sites, but this species has not been recorded as host specific.

Chrysodina globosa (Oliv.). Horn (1892) reported this small, round, dark beetle as common in the middle states, west to Colorado and Arizona. Douglas (1929) listed six specimens in Kansas collections, none of which are to be found in the Kansas State University collection. Wilcox (1954) stated that this species is found in southern Ohio.

No reference to host preference of this species could be found in the literature.

The absence of this species in the burned pastures indicates burned areas are not a suitable habitat for this insect. It appears to prefer the pastures that had deferred grazing for some unknown

reason. It is possible that the pastures with deferred grazing contain vigorous early spring plants for this early spring species to feed on. Pastures that are grazed in the spring may lack the desired host plants (tables 1 and 2).

The first specimens were taken on May 5. The peak population occurred in mid-May and the last specimens were collected June 20 except for two collected on August 11 and 18 which, were probably adults emerging to hunt overwintering quarters (table 7).

Pachybrachis autolytus Fall. This yellow and black striped, robust beetle was described by Fall (1915) from specimens, several of which were from Kansas. Wilcox (1954) states that this species should be found in Ohio but he had no specimens or records.

Smith (1940b) states that adults have no host preference and that larvae are all root feeders. Smith (1940a) found this species less prevalent in overgrazed, eroded pastures than in grazed pastures.

Fall listed June 12 to July as the time of occurrence for adults of this species. May 16 was the first date of collection and July 29 the last date recorded during this study. The peak was during June and the collections rapidly decreased early in July. The absence of the adults from August first to mid-May indicates a one year life cycle (table 7).

The abundance of adults in the Limestone breaks and small numbers collected on the other range sites indicates there may have been a preferred host in that area (tables 3 and 4).

Nodonata tristis (Oliv.). Horn (1892) reported this shiny, green beetle as inhabiting the middle states including Kansas, southward to North Carolina. Wickham (1902) recorded it from Colorado.

Blatchley (1910) stated that it loves on various herbs and shrubs, and Horn (1892) reported it living on upland weeds, Lespediza, and Ceanothus. Hendrickson (1929) listed this species as being common in Iowa at Andropogon scoparius-Boutelous curtispindula climax sites.

This species appears to have one generation per year since no adults were collected before June 2 or after July 22. This agrees with Henderson's collection dates in Iowa which were June 23 to July 26. The peak population (table 7) was during the last three weeks of June with only twelve specimens collected in July. Adults of this species probably live a short time (table 7).

Galerucella americana (Fab.). This brown beetle Horn (1893) covers the entire region east of the Rocky Mountains and the Rio Grande, and extends from Canada to the Gulf. Wickham (1897, 1902) records it also in Canada and Colorado, respectively. Douglas (1929) records this species from four counties in Kansas during July.

Woods (1924) stated that there is no known host of this species. Judging from its even distribution it is a general feeder or feeds on an abundant plant which occurs in all the bluestem pasture sites in this study.

Hendrickson (1929) reported that this species occurred in Iowa from June 30 to August 9 in 1928. During this study the earliest specimens collected were May 5 and the latest October 22. This indicates the winter was spent as adults. Two small peaks appeared, one in June and the other in August with a near absence of adults in July. The occurrence of adults in this seasonal distribution suggests

two generations a year in Kansas, or an extended hibernation period (table 6).

Altica foliaceae Lec. This blue, or green beetle was reported by Douglas (1929) from ten counties located throughout Kansas. Other records are Wilcox (1954) Ohio, Wickham (1902) Colorado, Gentner (1926) Canada, and Folsom (1936) Arizona, New Mexico and Louisiana. Wilcox and Gentner recorded primrose (Oenothera) and evening primrose (O. biennis), respectively, as host plants while Beutenmuller (1890); Folsom; Quaintance, and Siegler (1952) list apple trees as a preferred host. Quaintance and Siegler call it the apple flea-beetle but this name does not appear in the list of common names of insects (Laffoon 1960). Smith (1940b) reported this species occurs chiefly in climax prairie in Oklahoma. Wickham lists Cururbita perennis as another host.

Three species of Oenothera were present in the area studied: O. missouriensis, O. serrulata, and O. speciosa; also present was Cururbita foetidissima. In this study it was impossible to determine which, if any, of these is the preferred host.

Douglas gave May-September as the time of occurrence in Kansas. During this study it occurred from May 15 to October 8 with a peak during July, and only a very few specimens recorded after the middle of August (table 6).

This species probably has a similar life history to the grape flea beetle A. chalybea. Metcalf, Flint, and Metcalf (1951) stated that A. chalybea passes the winter as adults which emerge early in the spring. They feed on the new grape leaves, and the females oviposit on the grape canes. The larvae feed, then pupate to adults

in late July and August. The adults feed until the approach of cold weather when they seek sheltered places for hibernation.

Systema hudsonias (Forst.). This flat, black flea beetle, according to Horn (1889) is found throughout the entire region east of the Rocky Mountains. Other records are Wickham (1902) Colorado, Blatchley (1910) Indiana, Forbes (1905) Illinois, and Douglas (1929) reports Kansas.

Blatchley listed greater ragweed (Ambrosia trifida), elder (Sambucus), and other weeds as hosts while Forbes added dock and stated that this species can be found on a large number of plants. Metcalf, Flint, and Metcalf (1951) called S. hudsonias the smartweed flea beetle.

This species was collected from May 15 to August 4 with the peak during the first two weeks of June. It appears to have one generation per year in Kansas (table 6).

Galerucella cribrata (Lec.). Mutchler and Weiss (1926) reported this eastern species in New Jersey, Wood (1924) Maine, Wilcox (1954) Ohio, and Hendrickson (1929) Iowa.

Mutchler and Weiss stated that G. cavicollis and G. cribrata attack cherry and peach leaves on the under surface. They also reported observing the larvae eating Prunus pennsylvanica. Wilcox listed goldenrod as the host plant and Woods, Solidago nemoralis and S. juncea as being fed on in the field after he ran feeding trials with specimens of the genus Galerucella. In this study the specimens collected were predominately from Solidago populated areas.

Hendrickson collected this flat, brown colored beetle in Iowa, from June 30 to August 20. During this study the first specimens

were collected May 8 and the latest October 15, and the peak occurred during mid-June with specimens evenly collected until October (table 9).

This species has one generation per year (Woods, 1924). One generation a year was indicated during this study by the early peak, and then a slight increase in August and September. The peak in late summer represents the adults which hibernate during the winter (table 9).

Luperodes sp. This oblong, small-sized yellow beetle probably feeds on flower petals. This statement is made in light of the fact that other species of this genus feed on flowers and the group of specimens collected resemble yellow flower petals. Three species of Luperodes Douglas (1929) occur in Kansas and Wickham (1902) reported seven species from Colorado. Wickham (1897) observed Luperodes meraca feeding on flowers of wild rose and on witch hazel in Ontario and Quebec, Canada.

The species occurred from August 24 to October 15 and was most abundant during mid-September (table 9). This coincides with the presence of wild flowers. Although larvae were not observed, Luperodes sp. larvae probably are root feeders as are many other members of this tribe, such as the corn rootworm larvae. Assuming the larvae are root feeders, and that this species has one generation per year, the eggs must be laid very early in the spring by the overwintering adults, or they are laid in the fall. The former seems most logical as adults of other species of this genus become active during warm periods of the winter and disappear in the summer.

Diabrotica atripennis (Say). Blatchley (1910) stated that it occurred from Massachusetts to Kansas and Dakota but was not found in Indiana at that time. Wickham (1902) listed D. atripennis in Colorado, and Hendrickson (1929) observed it feeding on Polygonum amphibium leaves near Ames, Iowa from July 22 to August 9. Douglas (1929) records this species in Kansas from corn, radish, and Amorpha fruticosa.

During this study, this black species was collected from May 25 to July 28 with the peak from mid-June to mid-July (table 9).

Saxinus omogera Lac. This small, black beetle with a red spot on each elytra is found (Horn, 1892) from New Jersey to Georgia, Tennessee, and Texas. Blatchley (1910) reported specimens from southern Indiana, Wickham (1902) from five locations in Colorado, and Douglas (1929) from seven counties in Kansas.

Blatchley reported collections of S. omogera from roadside foliage in Indiana and no other indications of host were found in the literature. Tilden (1949) reared S. saucia from ant nests. Other chrysomelid larvae that live with ants eat dried leaves. Possibly S. saucia and other species of Saxinus eat dry forage as do Coscinoptera larvae. Smith (1940a) reported that S. omogera occurs in pre-climax prairies in Oklahoma but was not present in climax prairies.

Douglas reported May and June in Kansas; and Blatchley reported May 17 to July 21, as the periods of adult occurrence in Indiana. During this study, May 16 was the earliest date of collection and July 14 was the latest. The peak in the population occurred during the first three weeks of June (table 10).

Maecolaspis flavida (Say). Say (1824), when he described this species, gave its distribution as the United States.

The larvae of the common grape colaspis (Blatchley, 1910) are root feeders while the adults are leaf feeders. Decker (1948) reported adults of this species feeding on corn and the larvae causing damage to corn roots.

Adults were collected June 2 to August 11 during this study with a peak during the last two weeks of June and the first week of July. This species was probably a general feeder as it was found relatively evenly distributed in all pastures and pasture sites (tables 1, 2, 3, 4, and 10).

Coscinoptera axillaris Leo. This hairy, black beetle which has a red dot on each elytra was reported by Horn (1892) to be present from Colorado to Texas and east; Wickham (1902) listed six locations in Colorado. Douglas did not list this species from Kansas, even though the Kansas State University collection contains a number of Kansas specimens which were collected before that date.

Hendrickson found one specimen in Bouteloua curtipendula association prairie at Andropogon scoparius location near Sioux City, Iowa.

The earliest specimens were collected May 15 and the latest August 3 during this study (table 10).

Coscinoptera dominicana (Fab.). This black beetle with white fuzz is widely distributed from New England to the Dakotas and has been found in Arizona, Texas and Mexico (Horn, 1892). Other records include Blatchley (1915), Indiana; Wickham (1902), Colorado; Wilcox

(1954), Ohio; and Douglas (1929), Kansas.

Larvae have been observed (Riley, 1874 and Wickham, 1898) living in ant nests. Wickham took larvae from the nest of Formica obscuripes at Iowa City, Iowa. Riley stated that young larvae live on dead and decaying leaves found in the ant nest. Ant nests were not common in the vicinity of the present study.

Beutenmuller (1890), Wickham (1902), and Wilcox (1954) list several woody plants such as honey locust, sour gum, and oak as host for this species, which did not occur in the collection area. Douglas (1929) listed wild grape and sumac (Rhus glabra) which occurs in the areas studied.

This early spring species probably emerges as soon as its host plants leaf out. The earliest adults were taken May 8 and the latest July 1. Limestone breaks supplied more specimens than the other two soil types. That area also supports the heaviest sumac population (tables 3, 4, and 11).

Disonycha admirabilis Blatch. and D. leptolineata texana Schffr. These species were not separated in this study do to minute morphological differences. Probably only D. admirabilis was present according to originally keyed specimens. The material identified by Dr. D. M. Weisman indicated most of the specimens were D. admirabilis. Both species are medium sized, jumping beetles which are yellow with three black stripes down their elytra.

Wilcox (1954) reports D. admirabilis in Ohio feeds on Cossia sp. and Polygonum sp.

Cryptocephalus venustus Fab. The following locations have been reported for this widely distributed species: Colorado (Wickham, 1902),

Indiana (Blatchley, 1910), Iowa (Hendrickson, 1929), Maine (Phipps, 1930), Ohio (Wilcox, 1954), and Kansas (Douglas, 1929).

This robust, yellow beetle with two broken black lines on each wing is a general feeder and is reported by Wilcox as being common in meadows. Blatchley listed white top timothy and iron weed as host plants, Phipps added blueberries (Vaccinium) to the list, and Wickham reported Artemisia procunuloides as a host.

Douglas gave June to August for the occurrence in Kansas. This study includes specimens collected from June 17 to August 24 (table 11).

Pachybrachis pubescens (Oliv.). This species occurs from the Atlantic Coast west to Ohio (Fall, 1915). Wickham (1902) recorded eight locations from Colorado, Wilcox (1954) reported it in Ohio, and Frost (1947) reported it at Natch, Massachusetts.

This hairy and black species is normally a tree feeder. Frost collected one specimen on red oak, and Wickham reported willow leaves as one of its foods in Colorado. This species must feed on plants other than trees as it was collected in open areas away from trees, and it is doubtful if it migrates to the collecting areas for most Pachybrachis species are poor fliers.

Wilcox noted May and June as the time of occurrence in Ohio. Specimens in this study were collected from May 8 to July 1. The earliness of occurrence suggests that this species spends the winter in a semi-hibernation state as do the rootworm chrysomelids. It also appears to have only one generation per year in Kansas (table 12).

Adults occur predominately in Limestone breaks which may be a key to the location of a specific host plant (tables 3 and 4).

Bessareus lituratus var. recurvus (Say). This dark colored species with a yellow ring around the elytra and thorax was reported in Kansas by Douglas (1929), and in Indiana by Blatchley (1910).

Blatchley collected from May 12 to August 2 along roadsides and on hickory in Indiana. Adults were collected during this study from May 15 to July 1. It was well distributed as it occurred evenly in all three pasture sites and in all nine pastures (tables 1, 2, 3, 4, and 12).

Graphops simplex Lec. LeConte (1884) reported this species from Texas. Douglas (1929) did not report it in Kansas and it is not present in the Kansas State University Collection.

This shiny blue or green species was collected from May 15 to September 28. This distribution indicates that adults overwinter and emerge early in the spring to start the new generation (table 12).

Maecolaspis favosa Say. This species was reported by Horn (1892) as occurring in Kansas, North Carolina, Florida, and the Dakotas. Douglas (1929) reported it from ten counties in Kansas. He also stated, "this dull blue or green species was collected on apple leaves and was common at Clay Center, Kansas on Psoralea argophylla." Other host plants were corn in Nebraska (Swenk, 1910); Azaleas in Arkansas (English and Turnipseed, 1940); and numerous adults on Spartina and Polygonum amphibium near Amana, Iowa (Hendrickson, 1929). This species has been called the clover white grub because the larvae live in the soil on roots.

Hendrickson reported the earliest specimens in Iowa were collected June 23 and the latest August 26 during his studies. Douglas gave

June and July as dates of occurrence in Kansas. This study recorded only a few adults from June 9 to July 14 (table 13).

Disomycha triangularis (Say). Horn (1889) reported its occurrence in the entire region east of the Rocky Mountains in the United States and Canada. It is closely related to the spinach flea beetle which it resembles very closely. The main differing character is the three black spots on the yellow prothorax of D. triangularis which are absent on D. xanthomelas. Both species have dark, bluish-black elytra.

Blatchley (1910) listed beets, spinach, Chenopodium, and herbs as host plants; Wilcox (1954) added to this list Amaranthus. Walkden and Wilbur (1944) reported one specimen from bromegrass pasture and one from a new stand of alfalfa captured in a burlap trap in Kansas.

D. triangularis no doubt has a life cycle similar to that of D. xanthomelas which will be discussed as it appears in Metcalf, Flint, and Metcalf (1951). The adults overwinter and lay eggs on plants close to the soil surface in April and May. The larvae feed on the underside of the leaves from two to four weeks. They remain in the ground as pupae for ten days. After emerging the adults lay eggs which hatch and mature into the adults which overwinter.

The specimens in 1958 in this study appeared June 3 until July 7, then one specimen was collected September 18. This last specimen was no doubt one of the second generation adults which normally would have overwintered to start the new population for the next year (table 13).

Phyllecthris parallelus Horn. This narrow bodied beetle has blue elytra with a yellow stripe down the middle, extending to the prothorax. Horn (1893) recorded this species from Texas but stated

that its distribution was unknown.

Other species of this genus feed on clover so possibly this species feeds on legume plants also.

The earliest specimens were collected June 17 and the latest August 17. The adults were collected predominately from clay upland sites (tables 3, 4, and 13).

Oedionychis texanus Crotch. Horn (1889) and Blake (1927) reported O. texanus as occurring in Texas. It is medium sized and has a yellow base with two wide dark stripes on each elytron with a narrow one down the middle.

It was evenly distributed from May 25 to September 18 during this study (table 14).

Oedionychis thymoides Crotch. This species is generally distributed in the mid-United States. It resembles O. texanus but has a black background with a broad yellow band around the edge of the elytra. Blake (1927) listed specimens from Colorado, Kansas, Iowa, Tennessee, Ohio, Maryland, Louisiana, Mississippi, and Texas when she revised the genus Oedionychis.

Hosts of O. thymoides were given by Blake as Teucrium canadense, while Douglas (1929) reported this species from grass; Wilcox (1954) mentioned mint; and Hendrickson (1929) observed it feeding on Silphium laciniatum near Ames, Iowa.

Adults were collected May 16 to September 28 with only two of the 16 specimens collected from the clay upland sites (tables 3, 4, and 14).

Pachybrachis hepaticus (Melsh). This small, olive colored beetle according to Wilcox (1954) occurs in Ohio. Douglas (1929)

recorded it in eight Kansas counties, and Fall (1915) stated that it is common in the United States and Southern Canada. Wickham (1902) listed this species at four locations in Colorado and indicated it is probably a general feeder.

The fourteen specimens found during this study were, with the exception of two, collected in clay upland sites. This suggests a specific host of which there are no records. Specimens were taken from June 3 to September 11, indicating that this species has one generation per year in Kansas (tables 3, 4, and 14).

Phyllectris gentilis var. nigripennis Lec. This small narrow beetle was reported by Horn (1893) from Pennsylvania westward to Kansas, Dakota, and Montana, and south to Georgia and Texas. Douglas (1929) also listed this variety in Kansas.

Horn stated that Dr. Hamilton took P. g. nigripennis on Babinia pseudacacia. It is doubtful that this is the only host, for this species of plant is not listed as occurring in the area where the samples were taken during this study.

This variety was taken from May 5 to June 17 which indicates the adults emerge and oviposit early in the spring (table 15).

Exema sp. This is an interesting group of case bearing beetles (Pierce, 1940). The larvae (Brown, 1943) are found on plants of the Compositae family and have been reported on Compositae only. He listed Solidago, Artemisia californica, and Hymenoclea monogyra as common hosts of the genus Exema. Pierce stated that E. inyoensis occurs on sage (Artemisia tridentata), and Beutenmuller (1890) found E. gibber and E. conspersa on narrow leaf aster.

Jenks (1940) described the stages of Exema jenksi with several

fine pictures. He showed the eggs placed on the plants, suspended by short stalks. When secured the eggs are covered with a protective covering of excreta. The larvae upon hatching, pull the protective case loose from the stem and pull it after them when they move. They add to the case as they grow. The open end is glued to a solid limb before pupation. The adults emerge looking exactly like the dropping of a Lepidopterous larvae. Pierce reported that adults of E. jenksi are active the year around in Los Angeles County on Artemisia californica. During this study, adults were collected from June 9 to September 15 (table 15). They apparently have one generation per year.

Lema sp. near coloradensis Linell. This brilliant blue beetle is very similar to L. coloradensis and was keyed out by the author as that species. L. coloradensis was reported from Colorado by Wickham (1902) but is absent from the list of Kansas Chrysomelidae (Douglas, 1929), from the Kansas State University collection, and from the Snow collection at the University of Kansas.

Specimens were collected May 9 to August 3 (table 15).

Monoxia sp. Specimens similar to the one collected during this study were among material observed by Doris Blake (1927) of the United States National Museum when she described several new species, but left some material as Monoxia sp. Wickham (1902) recorded four species of Monoxia in Colorado and Fautin (1946) reported that Monoxia sp. was the most prevalent chrysomelid on the shrub layer of plants in the desert he studied in western Utah. He listed several shrubs which were present in an area where few other plants were growing. The plants he listed as being present were Tetradymia, shadscale, Indian rice grass, galleta grass, rabbit brush, bud sage, prickly

pear, and big sage brush.

Specimens collected from June 3 to August 4 totaled seven. The three collected in 1959 were all collected the same date from the same location (tables 2, 4, and 16).

Anisostena nigrita (Oliv.). This elongate, black beetle with ridged elytra was reported by Douglas (1929) as being common from July to August in five Kansas counties, including Riley County.

A. bicolor (Call, 1930) is a leaf miner on leaves of Tripsacum dactyloides in Kansas. Maulik (1932) reported A. fasciata on grass.

A. nigrita may have been feeding on T. dactyloides as it was present in the sampling area. Six specimens were collected from May 15 to August 17 during both years of this study (table 16).

Cryptocephalus sp. near confluens Say. This yellow robust beetle with black stripes on the elytra and a brilliant orange prothorax was very sparsely taken. Five specimens were taken on the following dates: May 25, June 2, and June 17 during 1959, from five different pastures. All three soil sites were represented (tables 1, 2, 3, 4, and 16).

Tilden (1949) took C. confluens from leaves of Baccharis pilularis.

Graphops varians Lec. LeConte (1884) reported it from Texas north to Kansas and Illinois. Wickham (1902) added Colorado, and Douglas (1929) reported thirteen specimens from Kansas. Smith (1940a) found G. varians more common in undisturbed prairie than in over-grazed or grazed prairie in Oklahoma. Hendrickson (1929) found this species common in Andropogon scoparius-Bouteloua curtipendula grass associations in Iowa from July 7 to August 6. Specimens in this

study were taken July 22 to October 1 from various locations (table 17).

Phyllobrotica decorata (Say). Horn (1893) reported it from Lake Superior through Illinois to Colorado. Wickham (1897) recorded it in southern Canada and (1902) in Colorado during June and July. Douglas (1929) reported specimens collected by Popenoe in Kansas during July by sweeping grass. Blatchley (1910) collected this beetle on the edge of marshes during June and July in Indiana.

The five specimens in this study were collected May 25, June 2, and June 3. Four came from Limestone breaks and one from clay upland sites (tables 3, 4, and 17).

Maecolaspis sp. prob. lata Schffr. This species was collected July 20 and September 1. The spotty collections may have been due to only occasional sampling of the host plants.

Four specimens were collected July 20 and September 23 (table 17).

Trirhabda canadensis (Kirby). Horn (1893) reported that the goldenrod beetle is one of the most widely spread chrysomelids. It covers the entire United States and most of Canada. This relatively large chrysomelid has two dull, yellow stripes down its back.

Blatchley (1910), Wilcox (1954), Wickham (1902), and Balduf (1929) all reported goldenrod (Solidago) as the host plant. Morrill (1915) reported it as destroying sage (Artemisia sp.) in Arizona, but Balduf stated that this host is incidental.

Balduf stated that this species has one generation a year. It lays eggs in soil and on dried leaves close to the food plants (Solidago). The eggs hatch in the spring and the larvae feed on the tender goldenrod leaves.

Specimens were taken June 23 to August 4, each one from a different pasture (tables 1, 2, and 18).

Nodonota puncticollis (Say). According to Horn (1892) this upland species occurs from Pennsylvania to Montana and southward to North Carolina. Other reports were Wickham (1902) Colorado, Blatchley (1910) Indiana, Douglas (1929) Kansas, Hendrickson (1929) Iowa, and Wilcox (1954) Ohio.

This species primarily lives on rose but may be found on various other herbs from May 28 to July 4 in Ohio (Wilcox). Hendrickson recorded Amorpha canescens as supporting numerous specimens which he called the rose leaf beetle. Other host references include wide rose or rose without listing a specific host.

Four specimens were recorded during this study, three during June and one August 18 (table 18).

Zygospila disrupta (Rogers). As the species name implies, it has broken black stripes on the yellow elytra and was referred to by Smith (1940b) as feeding on sunflower and other composites in Oklahoma. The genus Zygospila (Blatchley, 1910) is distributed over the southwestern United States and Z. disrupta probably follows this pattern. Posell (1932) reported its occurrence in south and southwestern Nebraska, feeding on alfalfa (Medicago sativa).

The larvae are root feeders on plants in the family Compositae, and Smith reported adults of Z. disrupta feeding on sunflower. He also reported that this species occurred in overgrazed pastures but not in Oklahoma natural prairies.

Four specimens were collected from June 2 to August 24 (table 18).

Chrysolina auripennis (Say). This is a very beautiful, shining,

golden green species of medium size. Blatchley (1910) quoted Linell as giving the range from Texas to Nebraska. Blatchley added Indiana and stated that C. auripennis occurs in sand dune regions, usually about prickly pear cactus. Douglas (1929) recorded this species from Riley County, Kansas. Walkden and Wilbur (1944) collected one specimen of C. auripennis from native hay in September by using burlap traps.

Three specimens were collected during this study on June 11 and September 15 (table 19).

Lema trilineata complex. These specimens will be considered as L. trilineata, for much of the literature on L. trilineata may also include the species collected during this study. Lema trilineata is the three-lined potato beetle which is common in the United States.

Beutenmuller (1890) reported Datura elramonium and Physalis as hosts and Wilcox (1954) reported L. trilineata throughout Ohio on Solanaceous plants.

June 2, July 22, and September 11 were the dates of collection during this study (table 19).

Myochrous squamosus Lec. This species was reported by Webster (1913) to range from northern Arizona and New Mexico to the Platts River in Nebraska and northwest into Montana.

The southern corn leaf-beetle (M. denticollis), a serious pest of corn in the Mississippi River water shed region, overwinters as adults in protected places such as clumps of grass Kelley (1915).

Myochrous squamosus probably acts similarly.

Douglas (1929) reported M. squamosus in Kansas during June. During this study adults were collected May 25 to June 23 (table 19).

Trirhabda borealis indigopecta Blake. This large chrysomelid is dull colored, with a yellow stripe on each elytra. Only two specimens were collected during this study, June 23 and July 7 (table 20).

Acalymma vittata (Fab.). The striped cucumber beetle, is discussed by Houser and Baldus (1929) as occurring in 34 of the 48 states of the United States. It has two generations per year in Ohio, the adults of one overwinter. The adults are a serious pest of cucumbers and the larvae do costly damage to corn roots each year. This species is known to feed on over sixty different plants.

Smith (1940b) in discussing succession on abandoned eroded farmland stated that A. vittata was collected in midseral stages and in climax prairie more than in prairies that are just starting toward the climax.

Only one specimen was collected during this study which involved near climax land indicating that this species does not move into native grasslands in this region.

Chlamisus sp. This case bearing genus, was represented by one specimen collected August 24, 1959 (table 20). This genus is referred to by Morgan and Maxwell (1953) as a pest of strawberries in Canada. The larvae and adults both cause damage to plants in May, June, and July. The adults overwinter and emerge in the spring to feed on strawberry, blackberry, blueberry, and huckleberry plants.

Diabrotica longicornis (Say). The green northern corn rootworm, was reported by Schwitzgebel and Wilbur (1942) to occur on Vernonia interior obtained from grassland habitats. This corn rootworm is distributed (Webster, 1913) from Nova Scotia southward to Alabama

and Mexico then westward to Minnesota, South Dakota, and Southern New Mexico.

This species contrary to its common name is a general feeder on many plants, but it has received most attention for the damage it has done to cucurbits and corn.

Microorhopala cyania (Say). McCauley (1938) stated that this central states inhabitant, occurs in Utah, Arizona, and Kansas. The larvae of this genus are leaf miners which seem to be limited to compositae plants as adults.

SUMMARY

During 1958 and 1959, chrysomelids were collected in a bluestem prairie near Manhattan, Kansas. The more abundant species collected (those contributing over 100 specimens) in descending order were:

Paria thoracica
Diabrotica undecimpunctata howardi
Galerucella notulata
Pachybrachis spp.
Zygospila suturalis casta
Pachybrachis othonus
Chrysodina globosa
Pachybrachis autolytus
Nodonota tristis
Galerucella americana
Altica foliaceae
Systema hudsonias
Galerucella cribrata
Luperodes sp.
Diabrotica atripennis
Saxinus omogera

Paria thoracica feeds mainly on goldenrod and occurred from May 23 to September 11, which correlated with the presence of goldenrod. In the clay upland sites, where 60 per cent of the goldenrod was counted, 62 per cent of the adults were collected.

Diabrotica undecimpunctata howardi was abundant during September and was collected May 16 to October 22. This general feeder apparently has one generation per year.

Galerucella notulata reacted to the presence of ragweed with a one year delay in population increase following an increase in plant populations, indicating that the adult population depended on the supply of food available to the larvae the previous year. There seemed to be two or more generations per year as the adults were collected from May 13 to October 29, with peaks during June and August.

Pachybrachis spp. consisted of several species, probably five or more, which were not identified. Even though many species were represented, 66 per cent of the adults collected during 1959 came from one third of the area studied.

Zygospila suturalis var. casta occurred predominately in clay upland sites in 1959 which was parallel with the occurrence of Ambrosia and Solidago. August was the month of abundance, and May 15 to October 15 was the period of occurrence.

Pachybrachis othonus was collected from May 16 to August 11, being most abundant during June.

Chrysodina globosa was collected from May 5 to August 18, with the majority of the adults occurring in May and June. One generation per year is apparent for this species.

Pachybrachis autolytus had one generation per year from May 16 to July 29. It is reported to be a general feeder, but this study indicated a possible host plant relationship in the limestone break sites.

Nodonota tristis was most abundant during June. It occurred from June 2 to July 22, which is a relatively short adult life.

Galerucella americana showed peaks in June and in August, indicating two generations per year. Adults of this general feeder were collected from May 5 to October 22.

Altica foliaceae probably fed on Oenothera and had one generation per year as does the grape flea beetle, a close relative. It was collected from May 15 to October 8, being abundant during July.

Systema hudsonias occurred from May 15 to August 4, being most abundant in June, indicating one generation per year.

Galerucella cribrata occurred from May 8 to October 15 and was most common in mid-June.

Luperodes sp. was collected from August 24 to October 15 and was common during September.

Diabrotica atripennis was collected from May 25 to July 28.

Saxinus omogera occurred from May 16 to July 14, being most common during June.

The first and last dates of collection for the other species were:

Species	Collection dates	
	First	Last
<u>Maecolaspis flavida</u>	June 2	August 11
<u>Coscinoptera axillaris</u>	May 15	August 3
<u>Coscinoptera dominicana</u>	May 8	July 1
<u>Disonychia admirabilis</u> and <u>D. leptolinata texana</u>	May 25	October 8
<u>Cryptocephalus venustus</u>	June 17	August 24
<u>Pachybrachis pubescens</u>	May 8	July 1
<u>Bassaricus lituratus</u> var. <u>recurvus</u>	May 15	July 7
<u>Graphops simplex</u>	May 15	September 28
<u>Maecolaspis favosa</u>	June 9	July 14
<u>Disonychia triangularis</u>	June 3	July 7
<u>Phyllethris parallelus</u>	June 17	August 17
<u>Oedionychia texanus</u>	May 25	September 18
<u>Oedionychia thymoides</u>	May 16	July 29
<u>Pachybrachis hepaticus</u>	June 3	September 11
<u>Phyllethris gentilis</u> var. <u>nigripennis</u>	May 5	June 17
<u>Exema</u> sp.	June 9	September 15
<u>Lema</u> sp. near <u>coloradensis</u>	May 9	August 3
<u>Monoxia</u> sp.	June 3	August 2
<u>Anisostena nigrita</u>	May 15	August 17
<u>Cryptocephalus</u> sp. near <u>confluens</u>	May 25	June 17
<u>Graphops varians</u>	July 22	October 1
<u>Phyllobrotica decorata</u>	May 25	June 3
<u>Maecolaspis</u> sp. prob. <u>late</u>	July 3	September 24
<u>Trirhabda canadensis</u>	June 23	August 4
<u>Nodonota puncticollis</u>	June 9	August 18
<u>Zygospila disrupta</u>	June 2	August 24
<u>Chrysolina auripennis</u>	June 11	September 15
<u>Lema trilineata</u> complex	June 2	September 11
<u>Myochrous squamosus</u>	May 25	June 23

Other species contributing two or less specimens were:

Trirhabda borealis var. indigoptera

Acalymna vittate

Chlamisus sp.

Diabrotica longicornis

Microrhopala cyanea

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SEASONAL OCCURRENCE OF CHRYSOMELIDAE IN A
BLUESTEM PRAIRIE NEAR MANHATTAN, KANSAS

by

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There are many publications concerned with Chrysomelidae taxonomy and with the economic species of this family such as the corn root-worms. However, few studies have been made on the seasonal occurrence of leaf beetles found in grasslands. This study is concerned with the seasonal occurrence of chrysomelid beetles found in bluestem pastures near Manhattan, Kansas during 1958 and 1959.

Occurrence of the leaf beetles in relation to pasture treatments and range sites is reported with the hope of aiding future research. This information helped to correlate beetle abundance with plant occurrence in specific areas.

Paria thoracica was abundant in clay sites in correlation with the occurrence of goldenrod (Solidago) in the same area. Ragweed (Ambrosia) was nearly twice as common in 1958 as 1957 or 1959; this apparently allowed a build up of Galerucella notulata larvae in 1958. As a result adults collected in 1959 far exceeded the number collected in 1958. Pachybrachis spp. occurred predominately in the lightly grazed pasture (66 per cent of the total), and the moderately grazed pasture (27 per cent of the total) leaving only seven per cent from the other seven pastures.

The first and last dates of collection, and the month of pear population for the most prevalent species were:

Species	Collection dates		Peak
	First	Last	Month
<u>Paria thoracica</u>	May 23	Sept. 11	June
<u>Diabrotica undecimpunctata howardi</u>	May 16	Oct. 22	Sept.
<u>Galerucella notulata</u>	May 15	Oct. 29	June
<u>Pachybrachis</u> spp.	May 5	Sept. 24	June
<u>Zygospila suturalis casta</u>	May 15	Oct. 15	Aug.
<u>Pachybrachis othonus</u>	May 16	Aug. 11	June

Species	Collection dates		Peak
	First	Last	Month
<u>Chrysodina globosa</u>	May 5	Aug. 18	May
<u>Pachybrachis autolyceus</u>	May 16	July 29	June
<u>Nodonota tristis</u>	June 2	July 22	June
<u>Galerucella americana</u>	May 5	Oct. 22	June & Aug.
<u>Altica foliaceae</u>	May 15	Oct. 8	July
<u>Systema hudsonias</u>	May 15	Aug. 4	June
<u>Galerucella cribrata</u>	May 8	Oct. 15	June
<u>Luperodes sp.</u>	Aug. 24	Oct. 15	Sept.
<u>Diabrotica atripennis</u>	May 25	July 28	June & July
<u>Saxinus omogera</u>	May 16	July 14	June

Thirty-five other species were represented in this study, but by relatively few specimens.